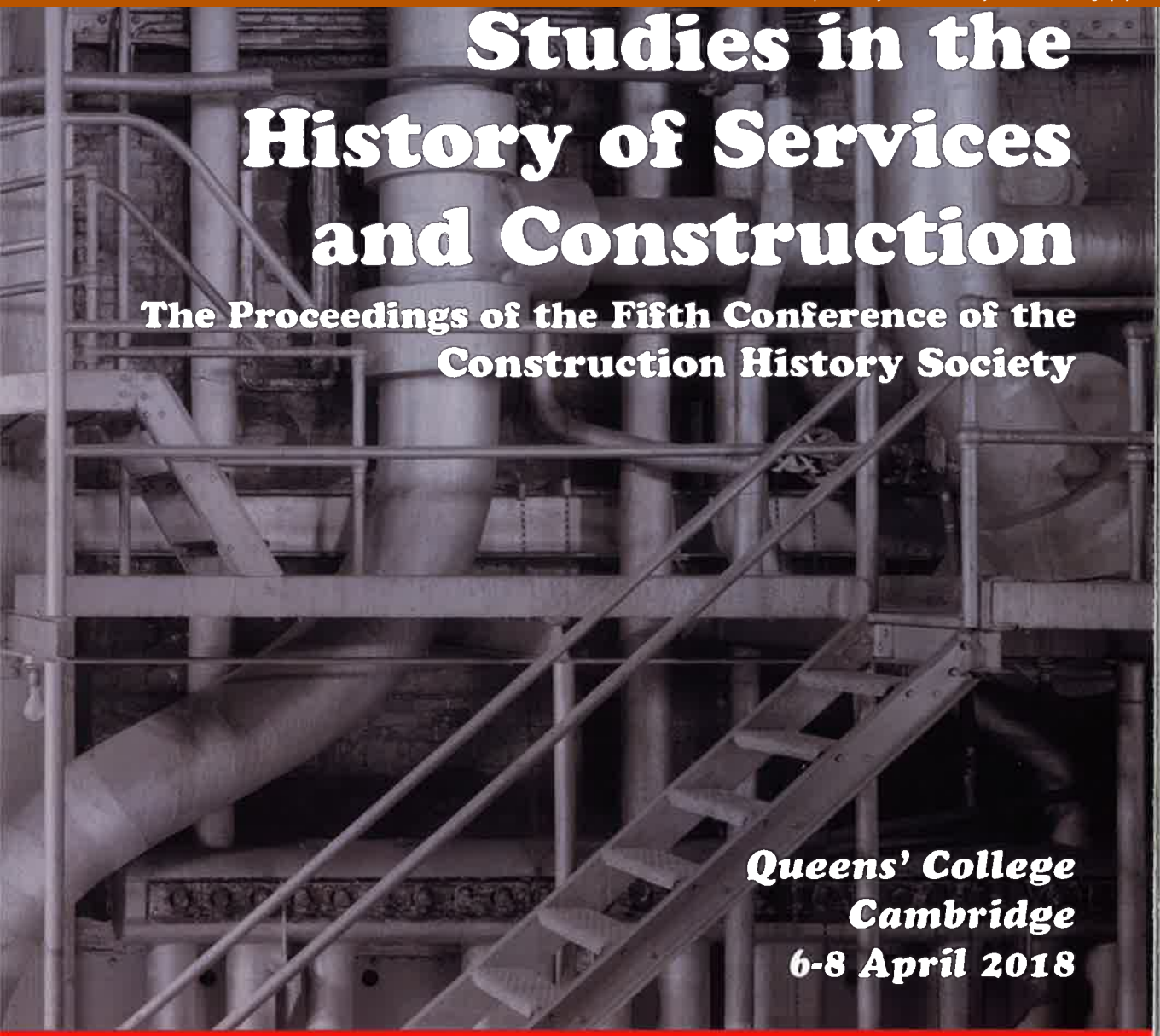

Studies in the History of Services and Construction

The Proceedings of the Fifth Conference of the Construction History Society

Queens' College
Cambridge
6-8 April 2018

Edited by
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Published by The Construction History Society
1 Scroope Terrace
Cambridge
CB2 1PX

www.construction.co.uk

© 2018, First Edition
ISBN 978-0-9928751-4-5

Formatting and layout by Yiting Pan
First printed by Lulu print on demand for the Construction History Society

Proceedings of the Fifth Construction History Society Conference
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THE FIFTH ANNUAL CONSTRUCTION HISTORY SOCIETY CONFERENCE

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Building services in nineteenth-century Belgian cellular prison architecture

Jozefien Feyaerts
Ghent University, Belgium

Introduction

Between 1850 and WWI, the Belgian state built a network of cellular prisons to facilitate the regime of solitary confinement. The cellular (as opposed to communal) regime was the crown jewel of the young nation's modern penal system, that had emerged from changing views on the custodial sentence since the eighteenth century.[1]

The Belgian prison system has been studied mainly from a penological and legal-historical point of view.[2] Apart from a few unpublished master theses, little research has been conducted on its remarkable nineteenth-century purpose-built infrastructure.[3] In his study of the radial cellular prison typology Norman Johnston does pay attention to the Belgian case, yet with a mere focus on the radial layout of the prison plans.[4]

Nonetheless, the cellular regime had not only made its mark through the distinctive star-shaped floor plan of the cellular typology. The solitary system presented architects with the challenge of reconciling conflicting needs for separation and seclusion on the one hand, and health and hygiene on the other. High demands were made regarding environmental control of the prisoners' individual cells. As a result, nineteenth-century cellular prisons were an experimental ground for environmental technologies such as central heating and forced ventilation which, according to Bruegmann, were "an essential determinant in 19th-century architecture".[5]

This paper explores the heating, ventilation, lighting and sanitary systems applied in individual cells in Belgium's prison patrimony during the heydays of the cellular regime. These developments are contextualised within the historical development of environmental techniques, as well as within the discourse on health and hygiene in reformed penal design. Sources include contemporary publications, official prison construction programmes, circulars, measuring states and correspondence of the Ministry of Justice.

Hygienic concerns in reformed penal design

Early prison reform in England

Health and hygiene had already been a battlepoint in early prison reform. In the eighteenth century, outbreaks of epidemic typhus or 'gaol fever' were believed to be caused by putrid airflows.[6] Eighteenth-century prison reform not only crystallised in a changed view on the custodial sentence (which had to reform rather than punish the prisoners through classification and separation); it also prioritized a healthy environment to achieve this purpose. Early English prison reform's protagonist John Howard (1726-1790) had promoted security, salubrity

and reformation as the "doctrines of reform".[7] These three "cardinal requirements of a reformed prison" brought about a change in penal design. [8] Reformed prisons necessitated a purpose-built infrastructure, reconciling the need for security (by means of enclosure), reformation through separation and seclusion (by means of compartmentalization) and salubrity through adequate water supply, drainage and ventilation (by means of exposure and fragmentation).[9] The material conditions of the prison had become crucial in achieving its penal goal.

The emergence of the regime of strict solitary confinement in the first half of the nineteenth century made prison architecture even more interlinked with its penal purpose. Prison reform had shifted its focus from preventing physical contagion, to preventing moral contagion. In order to avoid communication at all times, prisoners were now separated through the cellular architecture itself. With prisons becoming increasingly enclosed and cellularised, and hygienist requirements becoming more stringent as sanitary reform gained momentum, penal architecture needed yet again rethinking.[10] Earlier design principles based on the need for air and ventilation - basically turning prisons into "draughty and cold" "masses of small holes; large colanders jacked up on stilts"[11] - were no longer suitable.[12] The dilemmas that had already puzzled eighteenth-century reformed prison architects had only become more complex in the early nineteenth century. They boiled the conundrum down to the following question: "how could the circulation of air, water and waste be ensured in a place that is designed to impede the free movement of people?".[13]

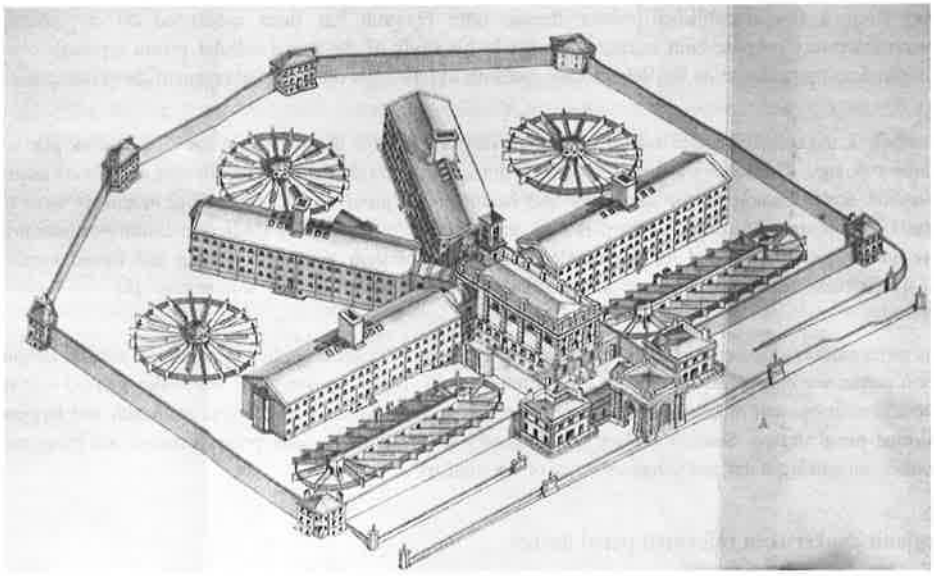


Fig. 1. Pentonville model prison (Description des plans de la prison modèle de Pentonville, s.l.: s.n., (ca. 1844), Pl. I.)

With technology rapidly evolving, architects experimented with new applications of heating, ventilation and sanitary services, which "found some of their earliest applications in the prisons of the first decades of the nineteenth century".[14] Pentonville prison (fig.1), constructed near London in 1840-42 as a model penitentiary,[15] indeed incorporated an innovative heating and ventilation system which was "one of the first

systems to confront the problem of providing warm air to a large number of rooms from a single source".[16] Pentonville presented such a degree of sophistication and scale in mechanical servicing that Evans does not simply consider it the most advanced prison, but even one of the most advanced buildings of its time.[17] As such, it thoroughly influenced prison construction in Britain and continental Europe in the second half of the nineteenth century.[18]

Prison reform in nineteenth-century Belgium

Pentonville became the blueprint for Belgian prison building as well. In the wake of international prison reform, the young Belgian state rigorously implemented the new cellular regime in its (at that time communal) prison system. Belgium's first General Inspector of Prisons Edouard Ducpétiaux (1804-1868) was the separate system's main advocate. Via solitary confinement during night and day, and through labor, education and religion, he believed the regime to intimidate and reform detainees, while preventing moral contamination by avoiding communication between prisoners.[19]

The introduction of solitary confinement in Belgium required a radically new prison infrastructure. Throughout the second half of the nineteenth century until WWI, nearly thirty new purpose-built cellular penitentiaries gradually replaced Belgium's outdated prison infrastructure. In several publications Ducpétiaux provided prison architects with guidelines on penal design.[20] He presented a framework for architects to explore different possibilities of construction, technology and their imagination within the requirements of the cellular regime. Inspired by Anglo-Saxon experiments (in particular the Pentonville model prison), Ducpétiaux advocated a radial layout of cell wings converging in a central observatory. Keeping abreast with technological developments and penal design experiments abroad, he also provided guidance with regard to the adequate ventilation, heating, lighting and sanitary services.

Ducpétiaux's ideas on prison architecture have been determinative for the Belgian state's cellular prison construction policy until well after his mandate as General Inspector from 1830 to 1868.[21] His concept of the cellular typology was broadly continued by his successor Jean Stevens, who published several essays and guides on penal design as well.[22] It was only near the end of the century that the strict cellular regime was gradually mitigated,[23] which inevitably influenced its architectural design as well. The following overview presents the main tendencies in the application of environmental technologies during the heydays of the cellular regime.

Environmental building services in the nineteenth-century Belgian prison cell

Heating

In Belgium's early days of cellular construction, Pentonville was the pre-eminent example regarding any aspect of penal architecture. That also included its innovative combined heating/ventilation system, known as 'the Pentonville system' (Fig 2). The basement under each cell wing contained a furnace room, heating fresh air to transport it to each cell through ducts within the inner walls. A vent above the cell door introduced the warm air, while foul air was extracted through a grill near the floor on the opposite side of the cell. Via pipes in the outer cell walls leading to a large duct in the attic, the foul air was eventually evacuated to a chimney. The warm air heating functioned at the same time as a heat-driven forced ventilation system; a continuous air circulation was activated and guaranteed by heating the exhaust shaft in order to produce a strong draft. Introducing air into the top of the cell avoided unpleasant draughts and ensured the airflow – at this height, detainees could not block the

vents. In order to prevent noise transmission and any form of communication, the air pipes were compartmentalized per cell.[24] Ducpétiaux specifically recommended the 'Pentonville system' in his memorandum in support of legislation on the cellular system in 1845.[25] It was applied in several projects around the middle of the nineteenth century; for example in the new cellular prison of Charleroi (1850),[26] the new cellular quarter of the Bruges prison (1851),[27] and the prison constructed in Verviers (1853).[28] Despite its innovative status, the system had its drawbacks which were increasingly subjected to critique. It lacked flexibility to adjust the temperature at nighttime - it took no less than 36 hours to lower the temperature in the cells. Heat was distributed in a very irregular way, depending on the orientation of the cells, their distance to the furnace room etc. Moreover, ventilation as well proved to be inadequate.[29]

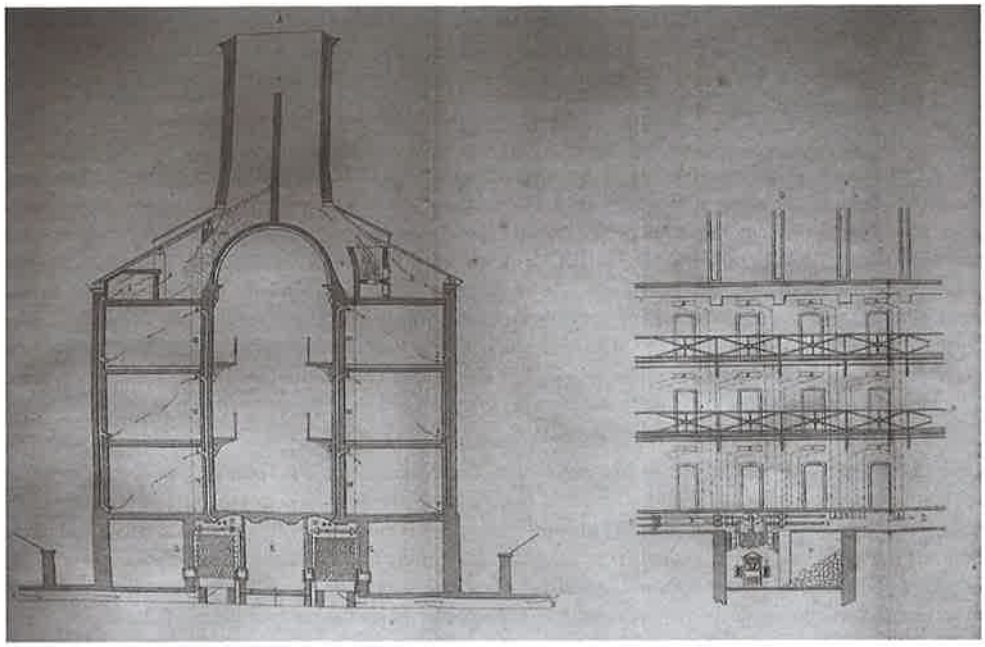


Fig. 2. The Pentonville warm air heating and ventilation system (S.n., Description des plans de la prison modèle de Pentonville, s.l.: s.n., (ca. 1844), Pl. IV)

To remedy these shortcomings, architects experimented with new combinations and arrangements. Henceforth, heating and ventilation were detached. Heating based on the circulation of hot water appeared to resolve most of the above mentioned issues.[30] A heater in the basement under each cell wing directed hot water to a special tank, placed in the exhaust chimney of the heating device. From there, the hot water was dispersed on each storey (Fig. 3-4). Two hot-water-filled pipes ran through the cells in the cell floor. Shielded by an iron plate, they provided a heat source in each cell. Through an opening in the iron plate, they uniformly released heat in the cells themselves and allowed a reduction of a few degrees when necessary. A valve on each floor could interrupt the circulation of hot water for a row of cells that were not occupied. [31] Hot water heating had been developed in the 1830s.[32] Around the middle of the nineteenth century, it was applied in prison construction abroad[33] and was introduced in Belgian penitentiaries as well. Architect Joseph-Jonas Dumont implemented the so-called 'thermosiphon' or low pressure hot water heating in the new prisons of Kortrijk (1853)[34] and Antwerp

(1853)[35]. A second cellular extension of the Bruges prison (ca. 1854), and Leuven central prison (1860) were also equipped with this system.[36] Instead of running the pipes through the cell floors, Stevens proposed in 1874 to place them ca. 50 cm above the floor, in an iron case over the width of the cell's outer wall, under the window (Fig. 5).[37]

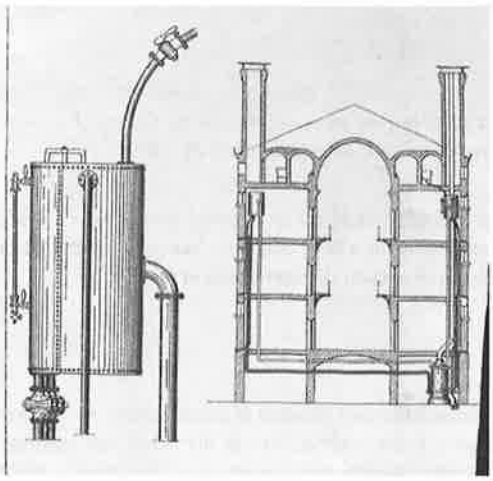


Fig. 3. 'Thermonsiphon' hot water heating system (J. Stevens, De la construction des prisons cellulaires en Belgique, Bruxelles: Muquardt, 1874, Pl. VIII)

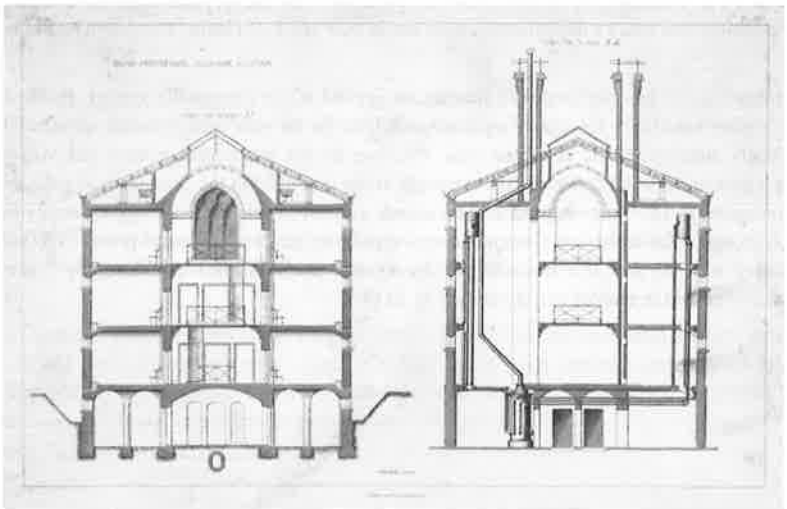


Fig. 4. Section of the Leuven central prison cell wings, illustrating the fixed toilet and water distribution system (l) and the thermosiphon heating system (r). Algemeen Rijksarchief, Ministerie van Justitie. Bestuur van de Gevangenissen en de Weldadigheidsinstellingen. Plannen van celgevangenissen II, 1822-1899, nr. 554. © Algemeen Rijksarchief

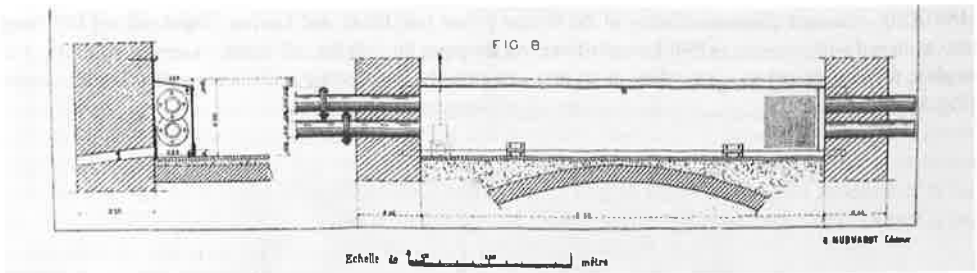


Fig. 5. Iron case to cover hot-filled heating pipes as proposed by Stevens (J. Stevens, De la construction des prisons cellulaires en Belgique, Bruxelles: Muquardt, 1874, Pl. VI)

Apart from the ordinary low pressure system, a high pressure system was used in the prison of Saint-Gilles.[38] This 'Perkins' system allowed heating of a large building - like the St-Gilles prison which housed 600 prisoners in five cell wings[39] – by means of a relatively short circuit of pipe.[40]

Ventilation

The ventilation of the cell demanded special attention in prison design. As we already mentioned had ventilation been a priority already in early prison reform, due to the belief that stagnant air caused disease.[41] The particularity of the cellular regime raised even more concerns. The prisoner spent about 22 hours per day – of which several laboring - in this 30 cubes space. The air was even more corrupted by the in-cell toilets. Therefore, a sufficient amount of fresh air was needed; preferably the air in the cell would be renewed every hour.[42] To prevent communication, natural ventilation by opening the cell window could was excluded. The tipping windows installed in most Belgian cellular prisons were to be used for supplementary ventilation, for example during the remaining two hours a day prisoners were not in their cell.[43] Hence, ventilation had to be forced.

Forced ventilation could be combined with heating, as applied in the Pentonville system. In the thermosiphon system, heating and ventilation functioned separately - at least for the most part. Although detached, both systems were still closely interlinked. The iron 'heat case' shielding the hot water pipes in each cell, was supplied with fresh air via a duct in the outer cell wall. The openings in the iron plate in the floor (or iron case above the floor as Stevens promoted in 1874) thus introduced heat as well as fresh air into the cell. Supplementary fresh air could be provided through a fan in the cell window, as was applied in the Leuven central prison (1860). Foul air was extracted through a 22-cm duct, near the ceiling on the opposite side of the heat and air supply. Via a large duct in the attic, the air was then evacuated to a chimney (Fig. 6).[44]

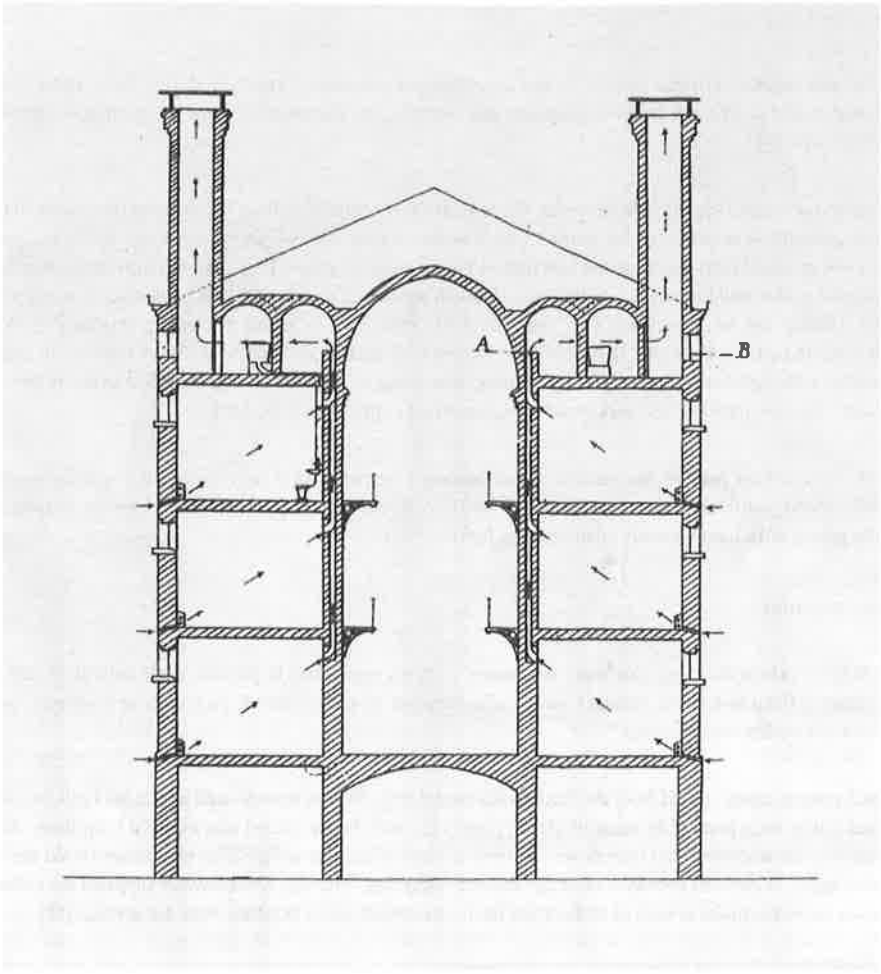


Fig. 6. Forced ventilation working separately from the thermosiphon heating system (J. Stevens, De la construction des prisons cellulaires en Belgique, Bruxelles: Muquardt, 1874, Pl. VII)

In his 1934 evaluation of the facilities in the Belgian prisons dating from the nineteenth century, Ernest Bertrand found these forced ventilation solutions inadequate.[45] In a time when separate confinement was no longer considered a panacea,[46] Bertrand advised to henceforth open the cell windows completely to suspend 'deceptive or annoying' forced ventilation through air vents altogether.[47]

Artificial lighting

In the cellular regime, artificial lighting in the cells was indispensable. Especially during long winter evenings, the prisoner could not be left hours in darkness and laziness. He also needed adequate lighting for performing labor in his cell.[48]

In the early days after Belgian independence, the only form of artificial light in the existing (non-cellular) prison buildings probably was provided by candles.[49] Candles, along with oil lamps from the 1820s on, were the predominant artificial light source in the first half of the nineteenth century.[50] By 1850 oil lamps were used in most Belgian prison buildings.[51] Gas lighting, although already in use since the early nineteenth century mainly in street lighting and large buildings,[52] was found too expensive to install in existing prisons.[53] With the introduction of petroleum in the 1850s,[54] the minister of Justice decided in 1863 to replace all lamps on rapeseed oil with petroleum lamps.[55] Gas lighting, according to Bertrand, was installed in every prison "a few years later". Electric lighting first appeared in Belgian prisons only after WWI.[56]

As for the new cellular prisons, the benefits of gas lighting were recognized early on, and the installation cost was apparently found justifiable for new construction. In 1837-38, the earliest program drafted for the construction of a cellular prison in Belgium already stipulated gas lighting.[57]

Sanitary facilities

In the Belgian prison building campaign, two major systems were used to provide each individual cell with a toilet. Either a fixed toilet was installed, which also required running water in each cell, or a simpler 'portable toilet' or toilet bucket was provided.

The fixed system, again copied from the Pentonville model (Fig. 7), was mostly used in prisons built before 1863. The fixed toilets were preferably made of glazed pottery or, even better, glazed cast iron. To keep them clean and odourless (the emanation of bad odours was a major concern in cellular design), running water rinsed the system when necessary. Water was provided via a tap above a fixed sink. The sink's wastewater supplied the toilet flush. Siphons in the waste pipes as well as in the toilet itself, prevented fumes to return from the sewage.[58]

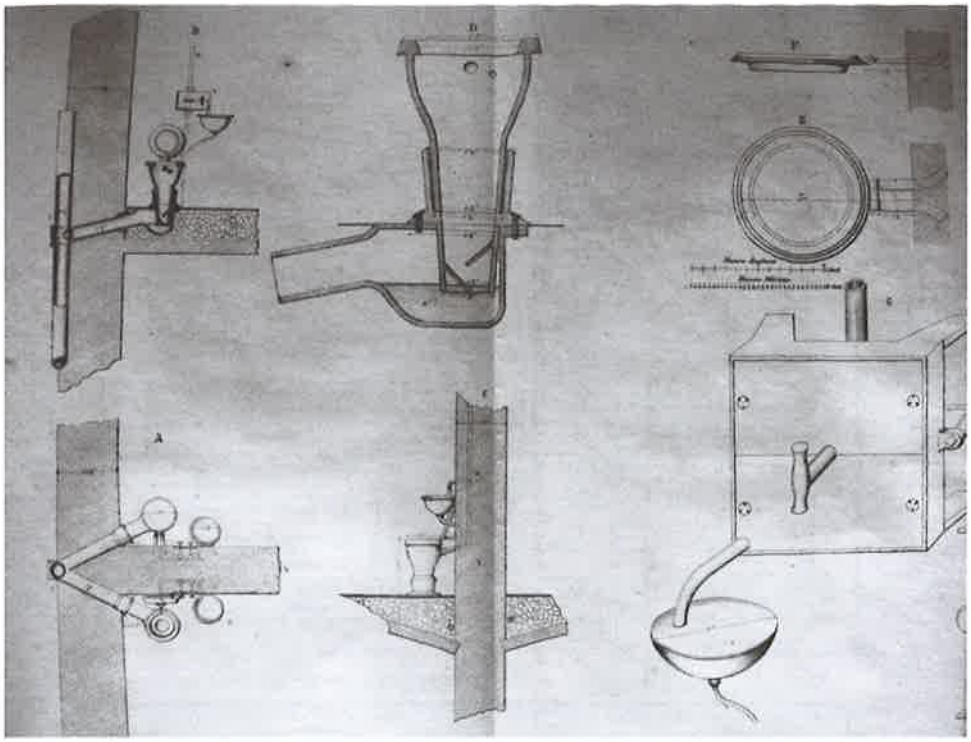
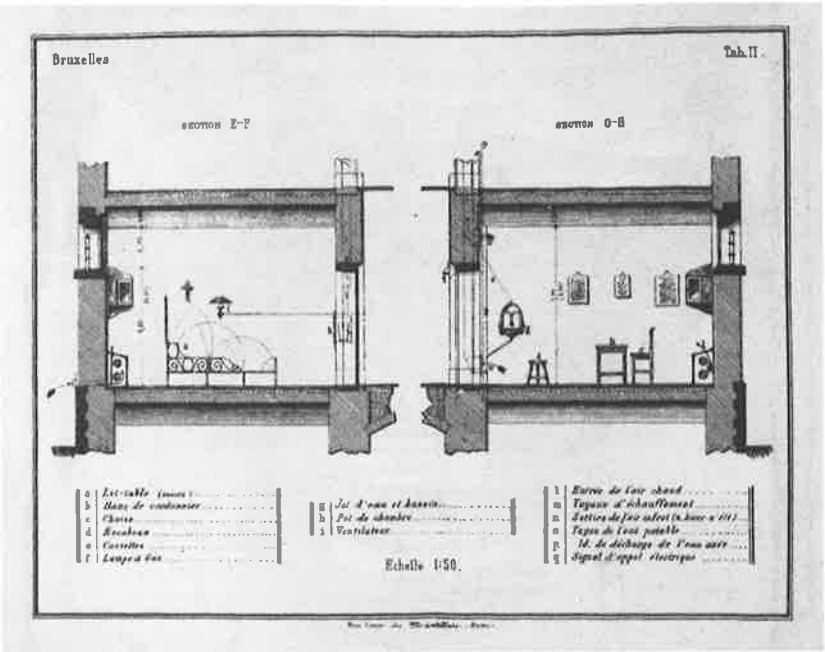


Fig. 7. Pentonville's fixed toilet system (S.n., Description des plans de la prison modèle de Pentonville, s.l.: s.n., (ca. 1844), Pl. VI)

Until 1863, Ducpétiaux had been a strong supporter of fixed toilets because of its ease of service. However, in order to function properly, the system necessitated water distribution in each cell via individual tanks of 25 to 30 litres, as well as seats and pipes made of solid and non-oxidizable materials that were drained to a septic well for each cell wing. These high demands could not always be met, and moreover they involved a considerable cost. Therefore, Ducpétiaux recommended in his étude de programme the use of 'portable toilets' which demanded an infinitely easier and cheaper installation. The toilet buckets, provided with a lid, were usually made of tin plate. They were placed in a ventilated niche in the wall towards the gallery, which were in some cases accessible via the gallery as well, by means of a double door. Emptied once or twice a day, toilet buckets did not require running water in the cells. Instead, prisoners were attributed a washbasin and water jug in pottery or stoneware. The jugs were filled with a daily supply of water from a tap installed per floor.[59]

In practice both systems were also combined, for instance in the prison of St-Gilles (1885). A ventilated niche contained a toilet bucket, while each cell was provided with running water and a fixed sink (Fig. 8).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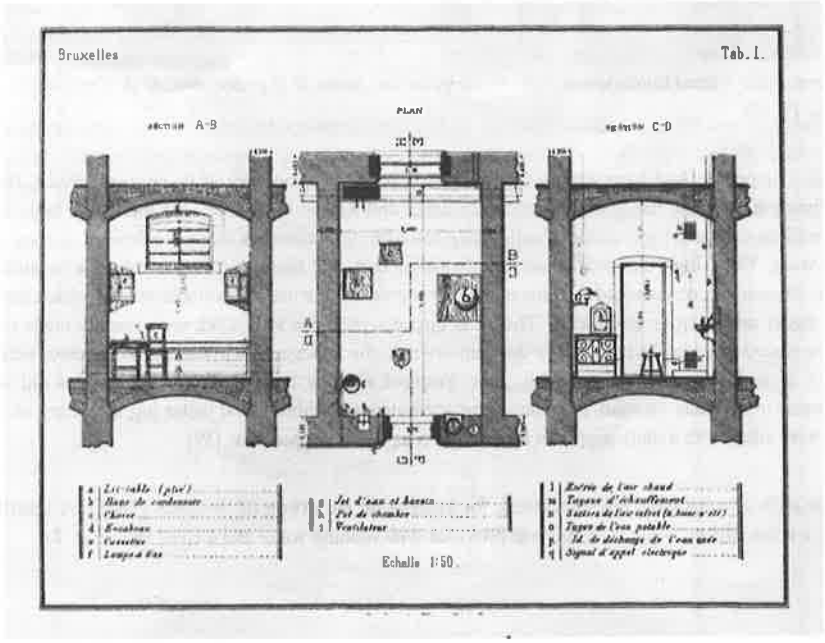
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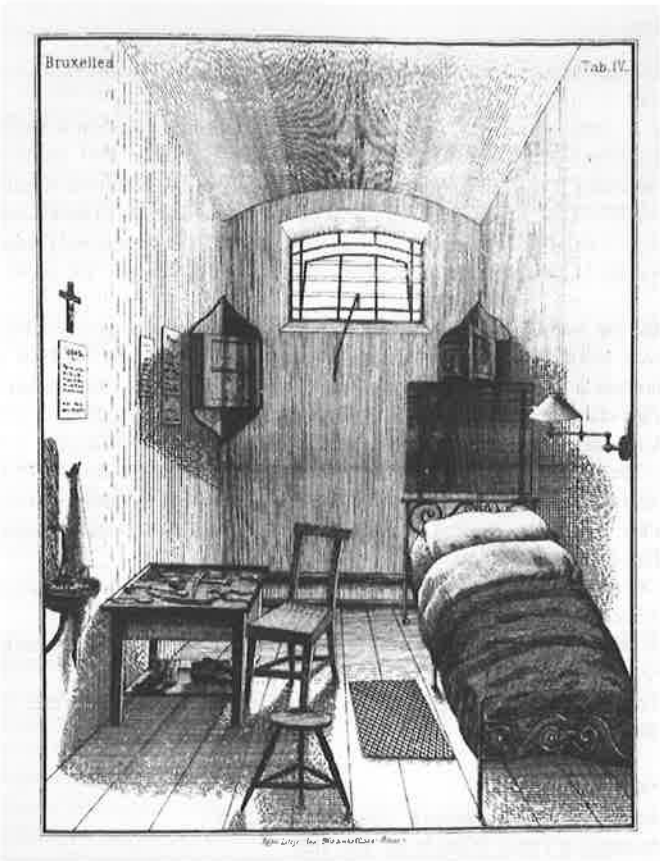

Fig. 8. Plans and sections of a cell in St-Gilles prison, with hot water heating, ventilation, gas lighting, a fixed sink with running water, and a toilet bucket in a ventilated niche in the inner cell wall (S.n., Actes du Congrès Pénitentiaire International de Rome 1885 (3 vols), Rome, 1888, Vol.3, Planches).

Conclusion

The implementation of the cellular regime in Belgium imposed high demands on its penal architecture. The new vision on the prison sentence had not only brought forward the need to provide for a single cell for every prisoner, it moreover had imposed an increased awareness on the importance of the prisoner's physical health for his moral recovery. The cellular prison typology was dependent on technologies of environmental control, that were rapidly developing in the nineteenth century and tested in several prison construction projects – abroad and in Belgium. Pentonville model prison's building services were copied in the first Belgian cellular prisons, following of Edouard Ducpétiaux' directives. Gradually, other systems like hot water heating or the portable toilet system were introduced in Belgian prison construction. It was only near the end of the century that the progressive loosening of the strictly cellular regime again rearranged the use of these building systems - a development to be further researched.

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[29] The Builder, Vol. 5 (9 October 1847), p. 484; Ducpétiaux, Des conditions, (Note 20), p. 15; Ducpétiaux, *Architecture des prisons cellulaires,* (Note 20), p. 19; Algemeen Rijksarchief, *Ministerie van Justitie. Bestuur van de Gevangenissen en de Weldadigheidsinstellingen. Reeks I, 1790-1927*, nr. 291, folder *Adjudication ...*, unnumbered document: annexe to measuring state, 10 February 1853.

[30] Ducpétiaux, *Des conditions*, (Note 20), p. 15.

[31] Stevens, *De la construction*, (Note 22), pp. 17-18.

[32] Bruegmann, 'Central Heating and Forced Ventilation', (Note 5), p. 148.

[33] Ducpétiaux, *Architecture des prisons cellulaires*, (Note 20), p. 19.

[34] Algemeen Rijksarchief, *Ministerie van Justitie. Bestuur van de Gevangenissen en de Weldadigheidsinstellingen. Reeks I, 1790-1927*, nr. 291, folder Adjudication ..., unnumbered document: annexe to measuring state, 10 February 1853.

[35] Algemeen Rijksarchief, *Ministerie van Justitie. Bestuur van de Gevangenissen en de Weldadigheidsinstellingen. Reeks I, 1790-1927*, nr. 270, folder *Concours...*, unnumbered document: 'Mémoire explicatif', s.d.

[36] Ducpétiaux, *Des conditions*, (Note 20), p. 15.

[37] Stevens, *De la construction*, (Note 22), p. 16.

[38] S.n., *Actes du Congrès Pénitentiaire International de Rome 1885* (3 vols), Rome, 1888, Vol.3, p. 36.

[39] Ibid.

[40] Bruegmann, 'Central Heating and Forced Ventilation', (Note 5), p. 148.

[41] Bruegmann, 'Central Heating and Forced Ventilation', (Note 5), p. 149.

[42] Stevens, *Les prisons cellulaires*, (Note 22), pp. 15-16.

[43] Ducpétiaux, *Architecture des prisons cellulaires*, (Note 20), p. 21; Stevens, *Les prisons cellulaires*, (Note 22), pp. 17-18.

[44] Stevens, *De la construction*, (Note 22), pp. 16-20.

[45] E. Bertrand, *Leçons pénitentiaires*, Louvain: Imprimerie administrative, 1932-34, p. 305.
[46] Johnston, *Forms of Constraint*, (Note 4), p. 107.
[47] Bertrand, *Leçons pénitentiaires*, (Note 45), p. 305.
[48] Ducpétiaux, *Architecture des prisons cellulaires*, (Note 20), p. 22.
[49] Bertrand, *Leçons pénitentiaires*, (Note 45), p. 463.
[50] M. Stokroos, *Verwarmen en verlichten in de negentiende eeuw*, Zutphen: Walburg pers, 2001, p. 63.
[51] Algemeen Rijksarchief, *Ministerie van Justitie. Bestuur van de Gevangenissen en de Weldadigheidsinstellingen. Reeks I, 1790-1927*, nr. 257, folder *Systèmes d'éclairage …* , unnumbered document: report on lighting, 1850.
[52] Stokroos, *Verwarmen en verlichten*, (Note 50), p. 72.
[53] Algemeen Rijksarchief, *Ministerie van Justitie. Bestuur van de Gevangenissen en de Weldadigheidsinstellingen. Reeks I, 1790-1927*, nr. 257, folder *Systèmes d'éclairage …* , unnumbered document: report on lighting, 1850.
[54] Stokroos, *Verwarmen en verlichten*, (Note 50), p. 69.
[55] S.n., *Receuil des circulaires, instructions et autres actes émanés du Ministère de la justice ou relatifs a ce département: 1861-1863*, Bruxelles: Weissenbruch, 1864, p. 506.
[56] Bertrand, *Leçons pénitentiaires*, (Note 45), p. 463.
[57] Ducpétiaux, *De la réforme pénitentiaire*, (Note 20), Vol 2, pp. 255-267.
[58] Ducpétiaux, *Architecture des prisons cellulaires*, (Note 20), pp. 23-27; Stevens, *Les prisons cellulaires*, (Note 22), pp. 29-33.
[59] Ducpétiaux, *Architecture des prisons cellulaires*, (Note 20), pp. 23-27; Stevens, *Les prisons cellulaires*, (Note 22), pp. 29-33.